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Corn Seed Treatment in Oklahoma

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SEED TREATMENT IS STAND INSURANCE.

Corn seed treatment may be properly regarded as seedling-emergence insurance. It should be a standard annual practice because environmental conditions which will follow planting cannot be accurately forecast and seed treatment chemicals are inexpensive and easy to apply. Treatment will assure better seedling emergence every season regardless of the environmental pecularities of a particular season.

Recommendations based on tests reported in this bulletin are:

1. *Buy only high-quality seed.*
2. *Ask for, and insist upon, treated seed.*
3. *If seed purchased is not treated, treat it at the farm with any of the commonly-recommended chemicals such as Arasan, Spergon, Semesan Jr. or Barbak-C. Arasan and Spergon have generally given slightly better results than the other chemicals and are recommended as first choice.*
4. *Treatment at the rate of one ounce of chemical per bushel of seed has given consistently good results.*
5. *Plant at the recommended time for your locality.*

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CORN SEED TREATMENT IN OKLAHOMA

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Corn seed treatment with chemical dusts has been shown to give better stands and yields in many sections of the United States, especially in the Corn Belt. In 1943, a group of Southern experiment stations organized under the leadership of the Oklahoma Station to test the value of corn seed treatment in the South. This bulletin presents the results obtained in Oklahoma from these cooperative tests, and gives additional information about the value of corn seed treatment and methods of treating seed.

In each of the three years of testing, corn seed treatment has increased seedling emergence 5 to 10 percent generally, and as much as 20 percent or more when cool, wet weather followed corn planting.

VALUE OF CORN SEED TREATMENT

Corn seed treatment frequently may mean the difference between a satisfactory seedling stand and one that must be replanted or planted to another crop. Replanting is seldom a satisfactory method of overcoming poor seedling stands because the later plantings fail to yield as well as the earlier plantings in most seasons. Also, it is just as time-consuming and even more expensive to care for a poor stand than it is for a good stand. The net return per acre is lower.[1] Planting an extra amount of seed to get a thick stand which must be thinned is costly in seed and time, and if thinning is not done at the right time the seedlings left standing in the field are injured. Poor stands always increase the cost of growing corn, because they waste seed and also waste labor at the time of year when extra work can be least afforded.

A poor stand of corn is usually blamed on seed that was poor in germination, and in many cases that is undoubtedly a part of the trouble. But there is another and probably more common cause of poor seedling stands. Every corn kernel usually carries upon its surface some spores (tiny microscopic "seed") of one or more kinds of fungi and bacteria. Fungi and bacteria also live in the soil. When seed are planted, the

[1] Based on a possible stand of 8,000 to 10,000 plants per acre, each one percent increase in germination results in 80 to 100 more plants per acre. A five percent increase results in 400 to 500 more plants per acre; a 10 percent increase, 800 to 1000 plants and a 20 percent increase, 1600 to 2000 plants per acre.

fungi on the seed and in the soil are able to grow and attack the kernels and young seedlings. When the rainfall and soil temperature conditions are just right, the fungi and bacteria suceed in either rotting the seed before it germinates or in killing the young, tender seedlings before or shortly after they emerge from the soil. Such losses are greatest when planting is followed by a cold, wet spell such as is quite often experienced in Oklahoma in April and May. Soil-temperature and soil-moisture conditions that are favorable for seed germination are likewise generally favorable for the life activities of the seed- and soil-borne organisms.

Seed treatment with chemical dusts provides an effective barrier against growth and entry of the organisms to the seed. A protective wall is formed around the seed. The amount of protection varies with the particular chemical used for treatment. Some chemicals seem to give added protection by diffusing into the soil around the seed and thus retarding fungous growth a short distance away from the seed.

COST AND METHOD OF TREATMENT

Cost.—The more expensive seed treatment chemicals cost approximately 15 cents an ounce when bought in small quantities. When purchased in one-pound sizes or larger the dusts are considerably cheaper. At a cost of 15 cents an ounce and treating at the rate of 1 ounce per bushel of seed, it will cost 15 cents to treat a bushel of seed. If the seed are planted at a rate of 7 to 8 pounds of seed per acre, it will cost approximately 2 cents an acre for the chemical to treat the seed. Most corn seed can probably be treated for 1 cent or less per acre.

Method.—Corn seed may be treated in a rotary or vertical barrel treater which can be made easily and cheaply from plans obtained free from the Du Pont Semesan Co. of Wilmington, Delaware. Large seed-treating machines are manufactured for seedsmen and others who treat large quantities of seed every year.

Many of the corn seedsmen, especially the producers of high-quality hybrid seed, are treating their seed before selling it. The buyers of such treated seed are thus assured of seed treatment protection without even the slight inconvenience of treating it at home. Dealers can afford to treat seed at very little additional cost to the farmers, and growers are entitled to this service by their seedsmen.

Caution: *Seed treatment chemicals are poisonous.* Treated seed must not be used for livestock or for human consumption. Care must be taken to avoid breathing the dust or get-

ting it on the skin while treating seed. Chemicals may burn when in contact with the skin. Treated seed may be saved for later plantings or for planting the following season.

RESULTS OF SEED TREATMENT TESTS

1943.—One experimental planting in 1943 compared the standard corn seed treatment chemical, Semesan Jr., with nontreatment on eight different seed lots. The seed were treated with an excess of chemical and then screened to remove the excess. Six replications were employed in a split-plot field design. In most instances the Semesan Jr. treatment resulted in seedling stand increases (Table 1). None of these increases was statistically significant because the soil was too dry for either seed germination or for seed rotting by pathogens.

A second type of seed treatment test was planted on two different dates to compare the protective values of five different chemicals with nontreatment. Of these five chemicals, Arasan and Dubay 1451-D were new ones previously untried on corn seed. The chemicals were applied in excess on the seed; the seed were then screened to remove the excess chemical. The results are shown in Table 2. In the planting made on April 19, treatment with each of the chemicals resulted in seedling stand increases in most instances and 40 percent of these increases were statistically significant. This planting was made in a soil which was below optimum moisture content at planting time. A majority of the seed had germinated by May 1 but the seedlings were not vigorous. Beginning on May

Table 1.—Corn seed treatment data showing percentage seedling stand increases resulting from treatment with Semesan Jr.

Source of seed	Variety	Percentage germination in laboratory test	Percentage infested by fungi	Mean seedling stand of nontreated seed	Percentage stand increases for Semesan Jr.
Oklahoma	Hays Golden	86	86	69.4	5
Mississippi	Mosby	84	84	77.5	2
North Carolina	Jarvis Golden Prolific	88	88	73.9	4
South Carolina	Woods Golden Dent	92	92	66.9	8
Virginia	Golden Queen	86	86	73.0	—1
Tennessee	Neal Paymaster	94	94	75.9	—2
Arkansas	Delta Prolific	90	90	70.8	--
Louisiana	Yellow Creole	94	94	77.4	--

Seed planted IV-16-43; seedling count made V-26-43; soil pH=5.5; mean temperature of 12-day period after planting=64.5° F.; rainfall in 12-day period after planting=trace; approximately 1 inch of rain fell during week preceding planting; soil moisture at planting time, below optimum.

Table 2.—Data showing the percentage seedling stand increases resulting from seed treatment with Arasan, Spergon, Semesan Jr., Barbak-D and Dubay 1451-D on five different seed lots

Seed lot, date of planting and date of counting	Mean stand count of non-treated	PERCENTAGE INCREASE OVER NONTREATED				
		Arasan	Spergon	Semesan Jr.	Barbak D	Dubay 1451-D
Oklahoma seed—Hays Golden						
planted IV-19-43; counted V-28-43	69	7	8	15*	9	16*
planted VI-4-43; counted VI-28-43	78	6	3	9	10	8
Virginia seed—Golden Queen						
planted IV-19-43; counted V-28-43	73	12*	5	7	−1	4
planted VI-4-43; counted VI-28-43	89	−9	−1	−5	−8	1
Mississippi seed—Mosby						
planted IV-19-43; counted V-28-43	76	--	13*	4	--	9
planted VI-4-43; counted VI-28-43	87	5	5	4	4	8
South Carolina seed—Woods Golden Dent						
planted IV-19-43; counted 4-28-43	62	23**	26**	31**	24**	31**
planted VI-4-43; counted VI-28-43	85	−2	--	−9	−10	−1
North Carolina seed—Jarvis Golden Prolific						
planted IV-19-43; counted V-28-43	73	10	6	4	5	14*
planted VI-4-43; counted VI-28-43	79	2	5	−1	4	2

* Statistically significant at 5% level.

** Statistically significant at 1% level.

The five seed lots used in these plantings were selected from the eight seed lots in the preceding test. Soil pH=5.7. Planting made on IV-19-43; soil moisture at planting time=below optimum; mean temperature of 12-day period afer planting =67.° F.; rainfall in 12-day period after planting=trace. Planting made on VI-4-43: soil moisture at planting time=optimum; mean temperature of 12-day period after planting=77.5° FF.; rainfall in 12-day period after planting=trace.

5, there was an excess of rainfall and soil temperatures were lowered. These conditions brought about seedling losses due to soil pathogens, so that the seedling count made on May 28 showed beneficial results from the various seed treatments. The planting of June 4 was made in soil with an optimum moisture content for seed germination and was followed by an additional shower. Soil temperatures were relatively high. The planted seed germinated within three to five days after planting. This planting was made especially late to determine whether seed treatment is beneficial in late plantings. Although the Golden Queen and Woods Golden Dent varieties did not appear to respond to seed treatment, Hays Golden, Mosby and Jarvis Golden Prolific responded with increases up to 10 percent.

A study was also made in 1943 of the application of eight different chemicals at various rates. Samples of the Neal Paymaster variety were treated at rates of 1½, ¾ and ⅜ ounces of dust per bushel of seed with the following chemicals: (1) Semesan Jr., (2) Spergon, (3) Dubay 1451-D, (4) Merko, (5) Barbak-D, (6) Dow 5, (7) Arasan and (8) AMAC-118.5C. There were no significant differences between the three rates of application, i. e., one rate was as satisfactory as either of the other two rates.

1944.—In 1944, early, medium and late plantings were made to compare the protective value of four different seed treatment chemicals on five different seed lots. Five replications were used. The chemicals were applied at the standard rate of 1½ ounces of chemical per bushel of corn seed. The soil moisture and temperature conditions both preceding and following each of these three plantings were very similar. There was an abundance of moisture and the soil remained cool. A period of approximately two weeks elapsed before emergence in any of the three plantings. Under such conditions seed treatment may be expected to be very beneficial, and Table 4 shows that seedling stands were significantly increased by treatments in a majority of the instances. The planting of April 6 was subjected to a hard pounding rain and later to blowing soil particles, both of which destroyed many seedlings.

Yield data obtained from the April 6 planting are presented in Table 5. Yields were increased at least 10 percent in 50% of the possible instances as a result of seed treatment. It was also observed in the field, and further verified by critical examination of the data, that the seedling stands were too thick to obtain maximum yields from the plots, i. e., the value of seed treatment in increasing yields was somewhat obscured.

In a test comparing Arasan, Spergon, Semesan Jr., Barbak-C and Dubay 1452-F at four different rates of application, no significant differences were found between the various rates for any one chemical. The chemicals were each applied at 2.5, 2.0, 1.5 and 1.0 ounces per bushel of seed. In a second test comparing rates of 2.0, 1.5 and 1.0 ounces per bushel of seed of different chemicals, no significant differences were observed between rates of Barbak-D, Dubay 1451-D, Merko, Dow 5, Merc-O-Dust, Zinc Oxide, Yellow Cuprocide, New Improved Ceresan, Sanoseed, Spergonex, or USR 604.

1945.—In a study made in 1945, both seedling emergence and yield data were obtained. Arasan, Spergon, USR 604 and Yellow Cuprocide were applied at a rate of one ounce per bushel of seed; Semesan Jr., Barbak-C and Dubay 1451-D were applied at one and one-half ounces per bushel and Dow 9A and Dow 9B were applied at two ounces per bushel. Planting was followed by cool temperatures and sufficient rainfall so that poor emergence was obtained from nontreated seed (Table 7). Each of the chemicals resulted in increases in seedling emergence and likewise in yields. Seedling emergence and yields were generally increased by 10 percent or more in most instances. Clearly, seed treatment was of marked value in this planting.

ORGANISMS ISOLATED FROM SEEDLINGS

In 1943, isolations were made from the mesocotyl region (point of seed attachment to first prop roots) of 100 seedlings of each treatment including the nontreatment. The seedlings were obtained by digging out the root systems of 600 plants when they were 8 weeks of age. The data are presented in Table 3.[2] Of the 100 seedlings grown from nontreated seed, only in 4 cases was there failure to isolate a fungus. The figures for the various treatments are much higher. It is clearly evident that many more fungi were obtained from the nontreated seedlings than from any of the treatments. The differences between the treated and nontreated seedlings were so clearly evident that workers in the laboratory could easily separate the treated from the nontreated. Isolations from the mesocotyl regions of seedlings grown from different seed treatments made in 1944 are presented in Table 6. The seedlings produced from nontreated seed were infested to a greater extent than those from treated seed. Spergon (non-volatile) did not appear to be as effective as the other three chemicals (all volatile). This relationship was also apparent in the 1943 isolation data. Various other species of fungi were isolated but so infrequently that they have been omitted from the table.

[2] Investigators generally regard *Diplodia zeae* as pathogenic, *Fusarium moniliforme* as mildly pathogenic and the other fungi isolated as saprophytic organisms incapable of causing such injury to corn seedlings.

Table 3.—A comparison of the number of isolates of various fungi isolated from the mesocotyls of corn seedlings at Stillwater in 1943.

Treatment	Number of plants examined	Fungi not obtained	NUMBERS OF FUNGI OBTAINED						
			Fmo	Cac	Rhi	Psp	Fsp	Dze	Total
Arasan	100	15	61	8	2	1	4	2	78
Spergon	100	17	50	9	13	3	3	–	78
Semesan Jr.	100	21	47	5	7	5	2	5	71
Barbak-D	100	16	30	9	13	11	5	–	68
Dubay 1451-D	100	23	47	1	5	7	3	1	64
Nontreated	100	4	83	2	3	3	–	–	91

Fmo—Fusarium moniliforme
Cac—Cephalosporium acremonium
Rhi—Rhinotrichum species
Psp—Penicillium species
Fsp—Fusarium species
Dze—Diplodia zeae

Table 4.—Corn seed treatment data showing percentage seedling stand increases resulting from various treatments at Stillwater in 1944.

Seed lot, date of planting and date of counting	Mean stand count of nontreated	PERCENTAGE INCREASE OVER NONTREATED			
		Spergon	Semesan Jr.	Barbak C	Dubay 1452-F
Oklahoma seed—Wood's Corn (89% germination)					
planted III-31-44; counted V-5-44	61	9*	8*	12**	16**
planted IV-16-44; counted V-5-44	35	48**	56**	32	42*
planted IV-18-44; counted V-11-44	56	33**	29**	15**	28**
Virginia seed—Golden Queen (98% germination)					
planted III-31-44; counted V-5-44	89	2	4	5*	2
planted IV-6-44; counted V-11-44	78	1	—5	1	–
planted IV-18-44; counted V-11-44	87	7*	9**	7*	12**
Mississippi seed—La. Hybrid 468 (80% germination)					
planted III-31-44; counted V-5-44	77	12**	5*	2	5
planted IV-6-44; counted V-11-44	53	26*	9	—4	11
planted IV-18-44; counted V-11-44	53	8*	1	2	7*
South Carolina—Hastings Prolific (94% germination)					
planted III-31-44; counted V-5-44	85	7**	8**	7**	4
planted IV-6-44; counted V-11-44	63	20*	8	20*	5
planted IV-18-44; counted V-11-44	88	6*	–	2	1
North Carolina—Jarvis Golden Prolific (95% germination)					
planted III-31-44; counted V-5-44	87	8**	3	6*	3
planted IV-6-44; counted V-11-44	71	14	—3	5	10
planted IV-18-44; counted V-11-44	87	6*	4	6*	6*

* Statistically significant at 5% level.
** Statistically significant at 1% level.
Planting of March 31: mean temperature of 12-day period after planting=57.7° F.; rainfall in 12-day period after planting=1.8 inches. Planting of April 6: mean temperature=59° F.; rainfall=1.8 inches. Planting of April 18: mean temperatures 59.7° F.; rainfall=2.9 inches.

Table 5.—Data showing the percentage increases in yield for the various varieties due to seedling stand increases as a result of seed treatment. Planted April 6, 1944; harvested October, 1944.

Variety	Mean yield in lbs. of nontreated	PERCENTAGE INCREASES IN YIELD FOR TREATMENTS			
		Spergon	Semesan Jr.	Barbak-C	Dubay 1452-F
Woods corn	11.5	12	14	13	16
Golden Queen	10.1	3	34	32*	9
Jarvis Golden Profilic	10.3	5	5	27	— 7
Hastings Profilic	12.5	1	1	—19	—25
Louisiana Hybrid 468	10.1	16	16	42*	5

*Statically significant at 5% level.

Table 6.—A comparison of the number of isolates of various fungi isolated from the mesocotyls of corn seedlings at Stillwater in 1944.

Treatment	Number of plants examined	PERCENTAGE FUNGI WERE ISOLATED				
		Fmo	Fsp	Cac	Tsp	Total
Spergon	60	32	15	--	22	69
Semesan Jr.	80	26	11	--	18	55
Dubay 1452-F	40	8	25	2	23	58
Barbak-C	40	5	28	--	20	53
Nontreated	30	53	3		20	76

Fmo=Fusarium moniliforme
Fsp=Pusarium species
Cac=Cephalosporium acremonium
Tsp=Trichoderma species

Table 7.—Corn seed treatment data showing percentage increases in seedling emergence and yield resulting from various seed treatment chemicals at Stillwater in 1945.

Seed lot, date of planting; date of counting and type of data	Mean data of non-treated	PERCENTAGE INCREASE OVER NONTREATED								
		Arasan	Spergon	Semeson Jr.	Barbak C	USR 604	Dubay 1451-D	Dow 9A	Dow 9B	Yellow Cupro-cide
Oklahoma seed—Hays Golden (97% germination) planted IV-5-45; counted V-5-45										
seedling emergence data	78	14**	13**	14**	16**	14**	16	10**	18**	4
yield data	31	24**	--	9	16*	24**	14	19*	21*	16*
Virginia seed—Golden Queen (91% germination) planted IV-5-45; counted V-5-45										
seedling emergence data	76	10	11**	12**	6	5	8*	12**	9*	4
yield data	26	16	--	10	1	13	24*	5	14	1

* Statistically significant at 5% level.
** Statistically significant at 1% level.
Mean temperature of 12-day period following planting =59.5° F.; rainfall in 12-day period after planting=1.89 inches; soil moisture at planting time=optimum.

3/46—7M